b. Natural Enemy Dynamics in Diversified Cropping Systems

i. Field evaluation of natural enemy dynamics in diversified and continuous wheat and soghum cropping systems.

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INTRODUCTION. The strategy of crop production through intercropping is viewed by many as a cornerstone for sustainable agriculture (Vandermeer 1989; Altieri 1994; Sullivan 1998). One of the benefits of intercropping is low insect pest pressure in production systems. Low insect pest pressure is an outcome attributed to factors explained by two hypotheses: the "natural enemy hypothesis" and the "resource concentration hypothesis" (Root 1973; Andow 1991).

The natural enemy hypothesis is based on the efficiency of predators and parasitoids in controlling herbivore populations in natural ecosystems. Natural ecosystems are typically characterized by spatial and temporal resource stability whereas resources in agroecosystems, dominated by monoculture, are ephemeral (Wiedenmann & Smith 1997). The ephemeral nature of resources is assumed to curtail the efficiency of natural enemies in monoculture production systems. Therefore, intercropping strategies, that ensure the spatial and temporal availability of resources to natural enemies, are considered to have pivotal components of sustainable insect pest management programs.

The objective of this study is to determine the potential of relay intercropping in enhancing natural enemy activities within the cereal production system. The goal is to determine how the mix of crops influences populations and communities of aphids and their associated natural enemies at the field scale. Preliminary results from this on-going study are reported.

MATERIALS AND METHODS. This study is being conducted at two sites, Perkins, OK and Chickasha, OK, and each site divided into nine plots. Three of the nine plots are diversified crops (40 x 160 ft strips of alfalfa, wheat, sorghum, and cotton), three are wheat monocultures (160 x 160 ft), and the remaining three are sorghum monocultures (160 x 160 ft). Each of these plots was randomly located within a 10.2 acre field. The plots are separated by 40 ft alleys that are kept fallow at all times. September 2003, plots were laid out at both study sites, during which alfalfa and wheat were planted in randomly selected areas [Note: sorghum and cotton will be planted in late spring and summer 2004, respectively and thus are not included in the results].

Predator Sampling: Random placement of a 0.5 m^2 quadrat (= a metal ring [80 cm diam. by 20 cm high]) in 4 random locations per plot followed by vacuuming each quadrat for 1.5 minutes with a suction sampler (Poulan PRO®). [Note that for monoculture plots only designated plot areas equivalent in size to diverse strips are sampled.] Density of predators is determined from counts per suction sample.

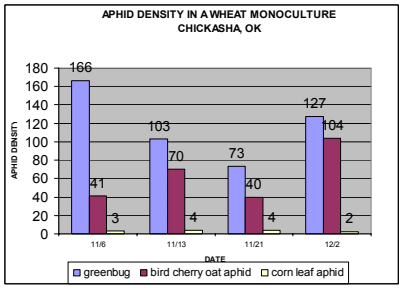
Densities reported are from 3 sampling dates for Chickasha (11/13/03, 11/21/03, and 12/02/03) and two sampling dates for Perkins (11/21/03 and 12/02/03). Yellow Pherocon® AM sticky traps mounted (stapled) on wooden stakes (2 ft above ground) so that the trap has two surfaces, east-facing and west-facing. Reported densities are from 2 sampling dates, 11/21/03 and 12/02/03, for each site.

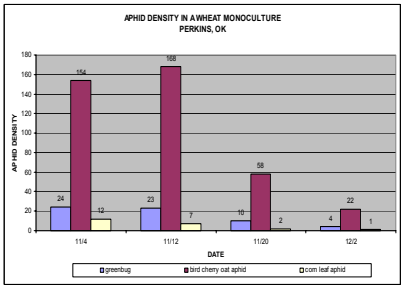
Aphid Sampling: A random selection of 100 tillers per wheat plot and a total of 50 stems per alfalfa plot was collected to determine aphid species density. Each tiller/stem was cut at

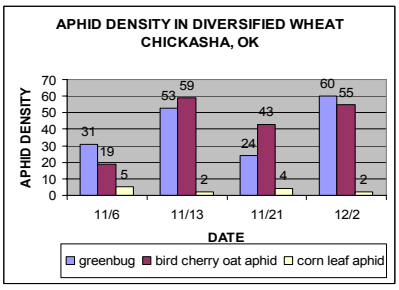
ground level, placed in a labeled bag until sorting and identification. Collected aphids were identified to species and enumerated. Mummies were counted and aphids dissected to determine percent parasitism, however, parasitism data are not included in the results.

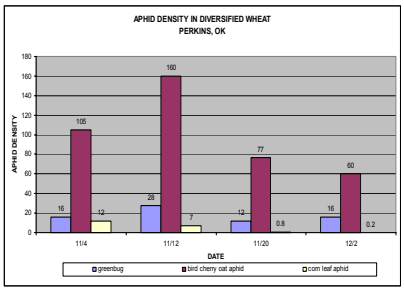
Analysis: Predator and aphid densities were statistically analyzed using a one-way analysis of variance, with monoculture wheat, diverse wheat, and alfalfa as factors. The analyses were done separately for each sampling date for each site.

RESULTS AND DISCUSSION. Aphid population densities (of individual species and the total number of co-occurring species) did not show any clear temporal pattern in Chickasha wheat plots (see figure below). This was unlike the situation in Perkins where densities of bird-cherry oat aphids (BCOA) were higher during early November. Furthermore, BCOA was the most abundant aphid in Perkins whereas this was not the case in Chickasha, where greenbugs were as abundant as BCOA. In terms of the comparison between aphid densities in wheat monoculture and diverse wheat, differences were only apparent in Chickasha where the wheat monoculture plots harbored more aphids in three out of four sampling dates. Although we did not statistically compare aphid densities between alfalfa and wheat it appears as though both wheat plots tended to have more aphids than alfalfa. The spotted alfalfa aphid was, in most cases, the only species found in alfalfa.









Population densities of many predators in Chickasha were relatively low across crop types during all three sampling dates (Table 1). For example, lady beetles like *Coleomegilla maculata* and *Coccinella septempunctata*, that are normally common in crops, were totally absent. Lady beetle larvae were actually found more often than the adults in suction samples. The most abundant predators in Chickasha were anthocorids (*Orius* spp.), anthicids, and spiders. Anthocorids were found almost exclusively in alfalfa. Anthicids and spiders were also significantly more abundant in alfalfa than in both diverse and monoculture wheat plots.

Table 1. Numbers of predators caught on Chickasha sticky traps

	PREDATORS						
CROP	Convergent l. beetle	Seven-spotted l. beetle	Pink-colored l. beetle	Rove Beetles	Green lacewings	Hover flies	Spiders
	DATE						
	November 25 / December 02						
Monoculture Wheat	0.1 / 0.1	0 / 0.03	0.1 / 0.1	0 / 0.6	0.9 / 1.2	1.3 / 2.6	0.2 / 1.8
Diverse Wheat	0.1 / 0.2	0.03 / 0.03	0.1 / 0.2	0 / 0.6	0.6 / 0.9	1.0 / 2.4	0.2 / 2.4
Alfalfa	0.1 / 0.1	0.03 / 0.08	0.2 / 0.2	0 / 0.9	0.9 / 0.9	1.6 / 3.1	0.1 / 2.2

In Perkins plots, population densities of most predators were also relatively low across the crop types and dates, with many averaging <1 per 0.5 m2 quadrat. Exceptions to this trend were found in anthocorids, staphylinids, anthicids, and spiders all of which occurred in significantly higher densities in alfalfa. Differences between diverse and monoculture wheat were significant only in the November densities of Anthicids. The occurrence of more predators in alfalfa than in the two wheat systems is an interesting outcome, especially given that the aphid density situation is quite the opposite.

Table 2. Numbers of predators caught on Perkins sticky traps.

	PREDATORS						
CROP	Convergent l. beetle	Seven-spotted l. beetle	Pink-colored l. beetle	Rove beetles	Green lacewing	Hover flies	Spiders
	DATE						
	November 25 / December 02						
Monoculture Wheat	0.03 / 0.06	0.03 / 0.03	0 / 0.03	0 / 0.7	0.9 / 0.9	6.6 / 17.8a	0.1 / 1.0
Diverse Wheat	0.03 / 0.06	0.03 / 0.03	0 / 0.03	0 / 0.4	0.7 / 0.7	7.9 / 19.5ab	0.06 / 0.6
Alfalfa	0 / 0.03	0 / 0	0 / 0	0 / 0.3	0.8 / 0.8	8.8 / 23.3b	0.03 / 1.0

Hoverflies were the only group of predators that appeared in relatively high numbers on the sticky traps. This was particularly the case in Perkins, where >20 flies per trap were found. It is important to note that there were very low densities of hoverfly larvae in the suction samples (Table 2). This implies either low reproductive activity during the sampling period or that the adults were not resident in the plots but only got attracted to the yellow color of traps.

LITERATURE CITED

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